

## EFFICACY OF INSECTICIDES AGAINST MAJOR INSECTS OF TOMATO IN MANIPUR

### ABSTRACT

A field experiment was ~~conducted to~~ evaluate the efficacy of some insecticides viz., Emamectin benzoate 5% ~~SG~~ (11 ga.i./ha), imidacloprid 17.8% SL (22.5 g a.i./ha), ~~n~~Neem oil (3ml/l), *Beauveria abassiana* (0.2ml/l), fipronil 5% SC (50 g a.i./ha) against major pests of tomato (*Lycopersicon esculentum* Mill.). There were six treatments arranged in randomized block design with four replications. Fruit borer, whiteflies, aphids and leaf miner were found to be the major insect pests of Tomato. Among the insecticide used, imidacloprid 17.8% SL was found to be the most effective for management of sucking pest viz., ~~W~~whiteflies, ~~A~~aphids, ~~T~~thrips, ~~M~~mealybugs, ~~J~~jassids while emamectin benzoate was found more effective on tomato fruit borer. *Beauveria abassiana* was found least effective against all the insect pests.

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Keywords: Tomato; Insect pests; Efficacy; Insecticides.

### 1. INTRODUCTION

Tomato, *Lycopersicon esculentum* (Mill.) is cultivated widely both for fresh market and processing. It is said to be a native of tropical America. Tomato tops in the list of canned vegetables and are used to produce sauce, chutney, juice, ketchup, puree, paste and powder. It is a perennial in its native habitat, although often grown outdoors in temperate climates as an annual herb. In India, tomato crop is mainly grown in the states of Maharashtra, Andhra Pradesh, Orissa, West Bengal, Karnataka, Jharkhand, Gujarat, Tamil Nadu, Uttar Pradesh, Rajasthan etc. Being a major vegetable in India, tomato is cultivated in 789.15 thousand ha area in

India with 19759.32 MT production and 25.03 tons per hectare productivity. Assam has the highest production of tomato in North East India which ~~produce~~produces 396.24 MT with an area of 18.28 Ha. In Manipur, tomato is grown over an area of 3.15 ha with a production of 33.72 ~~MT~~MT [1].

Insect pest act as a limiting factor in harvesting high yields of healthy and quality of tomato fruits. However, this important crop is attacked by about 16 insects and other pest species which caused damage to tomato crop in India. The key insect pests of tomato include fruit borer (*Helicoverpa armigera*), cutworms (*Arrotisipilon*), aphids (*Myzuspersicae*), thrips (*Ceraothripoides calaratis*), white flies (*Bemisia tabaci*), leaf miners (*Liriomyza trifolii*), flea beetles (*Chalaenosoma metallicum*), leaf bug (*Nesidiocoris tenuis*), green bug (*Nezarabiguttula*), mealy bug (*Pseudococcus cryptus*), spotted beetle, tomato hornworms, tobacco hornworms and Colorado potato beetles[2]. Among the various pests, the tomato fruit borer, *Helicoverpa armigera* Hub. (Lepidoptera: Noctuidae) is the most destructive due to its direct attack on fruits, high mobility, voracious feeding habit, high fecundity, multivoltine and overlapping generations. Several sucking pests cause appreciable damage to crop[3]. *Bemisia tabaci* alone can cause 10-90% damage depending upon the ~~severity of~~severity of the infestation and also transmits tomato yellow curl viruses[4]. The serpentine leaf miner, *Liriomyza trifolii* (Burgess) significantly reduced the yield and fruit quality by direct feeding[5].

Crop protection using chemicals is desirable and unavoidable part of integrated pest ~~management~~management [6]. The idea of controlling insect pests by using various agro-techniques in combination with selective use of insecticides making compatible with other components of the management of tomato insect pests are gaining importance as the most effective measure. Hence, the study on the efficacy of insecticides against major insect pest of tomato was undertaken.

### 2. MATERIALS AND METHODS

A field experiment was conducted during February to June, 2021 in a farm in Yurembam, Patsoi, Imphal West Manipur located at 24° 45' N latitude and 93° 56' E longitudes at an altitude of 790 m above ~~m~~Mean ~~S~~Sea ~~L~~level (MSL) to study the efficacy of insecticides against major insect pest of tomato in Manipur. The climate was humid subtropical with mild and dry winter having an average rainfall ranging from 974-2646 mm annually. The mean temperature during summer was 17- 30°C and 4-25°C during winter with a relative humidity of 36-100. The soil is alluvial and acidic in nature. The experiment was laid out in Randomized Block Design (RBD) with 6 treatments each replicated thrice. Tomato variety Sultan was sown at spacing of

75 cm plant to plant and 45 cm row to row. All the 24 plots were given uniform intercultural operations during the entire growth period of study. Irrigation was given every day during the initial stage of the plant growth and afterward regularly at 3-5 days interval. 1st spray was given at 50% flowering stage and 2nd spraying at 15 days interval. Pre-treatment count was done one day before both first and second sprayings and post-treatment count was recorded at 3, 7, 10, and 14 days after spraying for both the sprayings to observe the efficacy of different insecticides.

### 3. RESULTS AND DISCUSSION

Efficacy of treated insecticides on the seven major insect pests observed on tomato are  
insecticides on the seven major insect pests observed on tomato is being discussed below.

Efficacy of insecticides against Aphids, *Aphis gossypii*

The data obtained from the *Aphis gossypii* population are depicted in Table 1. Among the insecticides used, Imidacloprid 17.8% SL was found to be most effective against *Aphis gossypii* (70.67%). The findings are similar to Nderitu *et al.*[7] who recorded lowest aphid population in plot treated with imidacloprid (350 g L<sup>-1</sup>) causing more than 95 per cent aphid population reduction and slightly higher yields. The findings are in close relation with those of who Ghosal *et al.*[8] reported that imidacloprid 17.8 SL @ 50 g a.i. ha<sup>-1</sup> most effective against aphid showing least aphid infestation and 84.54 per cent reduction of population over control. Whereas Konar *et al.* [9] reported that imidacloprid @ 30 g a.i./ha was found most effective in reducing population of aphid.

Efficacy of insecticides against Whiteflies, *Bemisia tabaci*

The highest per cent reduction (reduction (Table 2) of whitefly population was observed on 10 days post spray in both first and second sprayings. Among the insecticides used, Imidacloprid 17.8% SL was found to be most effective (68.47%) against *Bemisia tabaci*. The per cent reduction of whitefly population (65.84% and 67.56% at first spray and second spray respectively) on 7 days post spray is supported by the studies done by Asif *et al.*[10] who reported that imidacloprid was highly effective with maximum reduction (63.24% at first spray and 66.77% at second spray) of whitefly population. Our findings are in agreement with Thorat *et al.*[11] who proved that imidacloprid 17.8 SL was the most effective for suppressing the whitefly population in tomato crop under field condition.

Efficacy of insecticides against Thrips, *Scirtothrips dorsalis*

Among the insecticides used (Table 3), Imidacloprid 17.8% SL was found to be most effective (67.47%) against *Scirtothrips dorsalis*. The per cent reduction of thrips population (66.15% and at first spray and 66.47% at second spray) respectively on 7 days post spray is supported by the studies done by Asif *et al.*[10] who reported that imidacloprid was highly effective with maximum reduction (68.51% at first spray and 70.35% at second spray) of thrips population. These results are in line with Moor *et al.*[12] who reported that Imidacloprid was the most consistent insecticide treatment for reducing thrips numbers and injury on peanut. Also, Prabhu *et al.* [13] reported that Imidacloprid 17.8% SL treatment recorded 25.07 per cent increase in the green chilli yield with a reduction of 70.47 per cent thrips damage over the untreated control and concluded that Imidacloprid could be used for the management of chilli thrips.

Efficacy of insecticides against Mealy bugs, *Phenacoccus solenopsis*

The highest per cent reduction of mealy bugs' population (population (Table 4) was found on 10 days post spray in both first and second sprayings. Among the insecticides used, Imidacloprid 17.8% SL was found to be most effective at first (74.92%) and second spray (76.36%) against *Phenacoccus solenopsis*. These results were in conformity with El-Mageed *et al.*[14] who reported that Imidacloprid reduced *Phenacoccus solenopsis* population up to 77.82 per cent on cotton.

Efficacy of insecticides against Jassids, *Amrascabiguttulabiguttula*

Among the insecticides used (Table 5), the mean reduction was found to be highest in Imidacloprid 17.8% SL treated plots (67.32%) against *Amrascabiguttulabiguttula*. However, Ghosaland Chatterjee[8] reported that highest percent reduction of jassid by Imidacloprid 17.8% SL was 84.72 per cent. This discrepancy between the two results might be because of the different degree of effectiveness of the pesticides on two dissimilar crops. The per cent reduction of jassid population (65.66% and 66.49% at first spray and second spray respectively) on 7 days post spray is supported by the studies done by Asif *et al.*[10], who reported that imidacloprid was highly effective with maximum reduction (66.66% at first spray and 63.49% at second spray) of jassid population.

Efficacy of insecticides against Leaf miners, *Liriomyza bryoniae*

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|  |      |                  |                  |                  |                  |      |                  |                  |                  |                  |       |
|--|------|------------------|------------------|------------------|------------------|------|------------------|------------------|------------------|------------------|-------|
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> )       | 2.50 | 52.65<br>(46.52) | 60.12<br>(50.86) | 67.74<br>(55.41) | 64.75<br>(53.60) | 1.70 | 52.78<br>(46.59) | 60.97<br>(51.38) | 68.33<br>(55.80) | 65.00<br>(53.74) | 61.54 |
| Imidacloprid 17.8% SL @ 68g a.i./ha: (T <sub>2</sub> )           | 2.55 | 58.58<br>(49.95) | 68.29<br>(55.76) | 78.15<br>(62.20) | 75.32<br>(60.24) | 1.65 | 60.70<br>(51.20) | 70.27<br>(57.08) | 79.40<br>(63.17) | 74.62<br>(59.87) | 70.67 |
| Neem oil @ 3ml/l of water: (T <sub>3</sub> )                     | 2.43 | 48.33<br>(44.04) | 56.44<br>(48.76) | 62.69<br>(52.51) | 58.52<br>(49.96) | 1.40 | 48.21<br>(43.97) | 56.70<br>(48.86) | 62.65<br>(52.35) | 60.86<br>(51.30) | 56.80 |
| <i>Beauveria bassiana</i> @ 0.2 ml/l of water: (T <sub>4</sub> ) | 2.85 | 38.86<br>(38.50) | 46.98<br>(43.22) | 54.17<br>(47.42) | 50.46<br>(45.28) | 1.85 | 37.55<br>(37.56) | 45.69<br>(42.52) | 56.19<br>(48.58) | 52.23<br>(46.28) | 47.77 |
| Fipronil 5% SC @ 50 g/l of water: (T <sub>5</sub> )              | 2.70 | 50.76<br>(45.44) | 57.42<br>(49.27) | 63.87<br>(53.06) | 60.23<br>(50.91) | 2.05 | 51.14<br>(45.65) | 58.84<br>(50.10) | 65.47<br>(54.07) | 63.20<br>(52.66) | 58.87 |
| Untreated control: (T <sub>0</sub> )                             | 2.10 | 0.00<br>(0.00)   | 0.00<br>(0.00)   | 0.00<br>(0.00)   | 0.00<br>(0.00)   | 3.10 | 0.00<br>(0.00)   | 0.00<br>(0.00)   | 0.00<br>(0.00)   | 0.00<br>(0.00)   | 0.00  |
| Sem±   | 0.15 | 1.55             | 1.97             | 1.94             | 1.89             | 0.16 | 1.65             | 1.37             | 1.47             | 1.46             | -     |
| CD (P=0.05)  | NS   | 4.66             | 5.93             | 5.84             | 5.71             | NS   | 4.97             | 4.13             | 4.43             | 4.40             | -     |

**Note:** Figures in the table are mean values and those in parenthesis are angular transformed values.  
NS: Non-significant at 5% level of significance.

Table 2 Effect of Different Pesticides Against Whiteflies, *Bemisia tabaci* on Tomato During February 2021 to June 2021

| Treatments   | Pre-treatment count | First spray       |                |                |                | Pre-treatment count | Second spray      |                |                |                | Mean  |
|--|---------------------|-------------------|----------------|----------------|----------------|---------------------|-------------------|----------------|----------------|----------------|-------|
|  |                     | Percent reduction |                |                |                |                     | Percent reduction |                |                |                |       |
|  |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |       |
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> )       | 2.80                | 52.20<br>46.26    | 58.53<br>49.94 | 65.80<br>54.26 | 60.20<br>50.90 | 1.80                | 55.59<br>48.21    | 61.49<br>51.94 | 68.65<br>56.32 | 65.83<br>54.48 | 61.04 |
| Imidacloprid 17.8% SL @ 68g a.i./ha: (T <sub>2</sub> )           | 2.30                | 57.59<br>49.45    | 65.84<br>54.27 | 75.69<br>60.52 | 73.44<br>59.03 | 1.70                | 58.31<br>49.81    | 67.56<br>55.31 | 76.05<br>60.75 | 73.24<br>58.89 | 68.47 |
| Neem oil @ 3ml/l of water: (T <sub>3</sub> )                     | 2.55                | 48.58<br>44.14    | 54.67<br>47.69 | 60.46<br>51.10 | 57.42<br>49.32 | 1.85                | 48.21<br>43.97    | 55.89<br>49.77 | 62.58<br>52.30 | 58.75<br>50.19 | 55.82 |
| <i>Beauveria bassiana</i> @ 0.2 ml/l of water: (T <sub>4</sub> ) | 2.70                | 36.21<br>36.99    | 39.33<br>38.82 | 46.48<br>42.98 | 40.55<br>39.54 | 2.00                | 37.34<br>37.66    | 40.10<br>39.21 | 48.05<br>43.78 | 42.37<br>40.52 | 41.30 |

|   |      |                |                |                |                |      |                |                |                |                |       |
|---|------|----------------|----------------|----------------|----------------|------|----------------|----------------|----------------|----------------|-------|
| Fipronil 5% SC @ 50 g/l of water: (T <sub>5</sub> ) | 2.65 | 50.65<br>45.37 | 56.57<br>48.78 | 62.97<br>52.53 | 60.40<br>51.01 | 1.80 | 50.42<br>45.24 | 56.25<br>48.62 | 64.17<br>53.27 | 60.83<br>51.27 | 57.78 |
| Untreated control: (T <sub>0</sub> )                | 2.60 | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 2.75 | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00  |
| Sem±  | 0.26 | 1.80           | 1.35           | 1.33           | 1.53           | 0.23 | 1.11           | 1.49           | 1.95           | 1.34           | -     |
| CD (P=0.05)   | NS   | 5.43           | 4.06           | 4.00           | 4.63           | NS   | 3.34           | 4.49           | 5.88           | 4.03           | -     |

**Note:** Figures in the table are mean values and those in parenthesis are angular transformed values.  
NS: Non-significant at 5% level of significance.

Table 3 Effect of Different Pesticides Against Thrips, *Scirtothrips dorsalis* on Tomato During February 2021 to June 2021

| Treatments   | Pre-treatment count | First spray       |                |                |                | Pre-treatment count | Second spray      |                |                |                | Mean  |
|--|---------------------|-------------------|----------------|----------------|----------------|---------------------|-------------------|----------------|----------------|----------------|-------|
|  |                     | Percent reduction |                |                |                |                     | Percent reduction |                |                |                |       |
|  |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |       |
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> )       | 2.05                | 52.18<br>46.25    | 57.56<br>49.37 | 66.48<br>54.62 | 62.44<br>52.22 | 2.00                | 52.07<br>46.20    | 58.70<br>50.07 | 67.10<br>55.02 | 63.40<br>52.95 | 59.99 |
| Imidacloprid 17.8% SL @ 68g a.i. /ha: (T <sub>2</sub> )          | 2.35                | 56.79<br>48.93    | 66.15<br>54.43 | 75.32<br>60.24 | 70.02<br>56.85 | 2.10                | 55.81<br>48.35    | 66.47<br>54.65 | 76.18<br>60.85 | 72.98<br>58.72 | 67.47 |
| Nem oil @ 3ml/l of water: (T <sub>3</sub> )                      | 2.20                | 48.52<br>44.15    | 55.30<br>48.05 | 62.44<br>52.22 | 57.83<br>49.51 | 1.70                | 49.35<br>44.63    | 55.82<br>48.36 | 64.12<br>53.21 | 58.75<br>50.04 | 56.52 |
| <i>Beauveria bassiana</i> @ 0.2 ml/l of water: (T <sub>4</sub> ) | 2.65                | 35.86<br>36.75    | 38.58<br>38.38 | 47.51<br>43.56 | 40.42<br>39.45 | 1.75                | 35.73<br>36.70    | 40.78<br>39.67 | 47.96<br>43.83 | 42.34<br>40.58 | 41.15 |
| Fipronil 5% SC @ 50 g/l of water: (T <sub>5</sub> )              | 2.20                | 50.44<br>45.25    | 56.69<br>48.85 | 62.09<br>52.02 | 60.61<br>51.13 | 1.65                | 52.92<br>46.68    | 57.54<br>49.36 | 62.90<br>52.48 | 60.11<br>50.84 | 57.91 |
| Untreated control: (T <sub>0</sub> )                             | 2.00                | 0.00<br>(0.00)    | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 2.90                | 0.00<br>(0.00)    | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00  |
| Sem±   | 0.22                | 1.38              | 1.00           | 1.15           | 1.20           | 0.28                | 1.28              | 1.29           | 1.12           | 1.44           | -     |
| CD (P=0.05)  | NS                  | 4.16              | 3.01           | 3.47           | 3.60           | NS                  | 3.87              | 3.89           | 3.37           | 4.33           | -     |

**Note:** Figures in the table are mean values and those in parenthesis are angular transformed values.  
NS: Non-significant at 5% level of significance.

Table 4 Effect of different pesticides against mealy bugs, *Phenacoccus solenopsis* on tomato during February 2021 to June 2021

| Treatments | Pre-treatment count | First spray       |       |        |        | Pre-treatment count | Second spray      |       |        |        | Mean |
|------------|---------------------|-------------------|-------|--------|--------|---------------------|-------------------|-------|--------|--------|------|
|            |                     | Percent reduction |       |        |        |                     | Percent reduction |       |        |        |      |
|            |                     | 3 DAS             | 7 DAS | 10 DAS | 14 DAS |                     | 3 DAS             | 7 DAS | 10 DAS | 14 DAS |      |

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|  |          |                 |                 |                 |                 |          |                 |                 |                 |                 |           |
|--|----------|-----------------|-----------------|-----------------|-----------------|----------|-----------------|-----------------|-----------------|-----------------|-----------|
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> )         | 1.8<br>5 | 52.52<br>46.45  | 56.79<br>48.93  | 65.75<br>54.20  | 60.70<br>51.18  | 1.9<br>0 | 52.41<br>46.38  | 57.63<br>49.41  | 66.44<br>54.61  | 59.72<br>50.61  | 59.0<br>0 |
| Imidacloprid 17.8% SL@ 68g a.i. /ha: (T <sub>2</sub> )             | 1.6<br>5 | 55.49<br>48.15  | 65.24<br>53.88  | 74.92<br>60.03  | 70.62<br>57.20  | 1.6<br>0 | 55.52<br>48.17  | 67.11<br>55.02  | 76.36<br>60.98  | 72.63<br>58.46  | 67.2<br>4 |
| Neem oil @ 3ml/lit of water: (T <sub>3</sub> )                     | 1.8<br>5 | 47.52<br>43.57  | 55.16<br>48.00  | 62.20<br>52.09  | 58.73<br>50.06  | 1.6<br>5 | 48.26<br>43.99  | 54.67<br>47.69  | 62.40<br>52.21  | 57.80<br>49.50  | 55.8<br>4 |
| <i>Beauveria bassiana</i> @ 0.2 ml/lit of water: (T <sub>4</sub> ) | 1.8<br>0 | 38.82<br>38.54  | 47.36<br>43.49  | 56.67<br>48.84  | 50.69<br>45.40  | 1.9<br>5 | 37.68<br>37.86  | 48.32<br>44.04  | 57.78<br>49.50  | 50.36<br>45.20  | 48.4<br>6 |
| Fipronil 5% SC @ 50 g/lit of water: (T <sub>5</sub> )              | 1.6<br>5 | 50.50<br>45.28  | 55.67<br>48.27  | 62.92<br>52.50  | 57.46<br>49.29  | 1.7<br>5 | 50.10<br>45.05  | 56.77<br>48.93  | 62.62<br>52.34  | 58.55<br>49.97  | 56.8<br>2 |
| Untreated control: (T <sub>0</sub> )                               | 1.6<br>5 | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 2.4<br>5 | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00      |
| Sem±   | 0.2<br>3 | 1.18            | 1.41            | 1.25            | 1.38            | 0.1<br>9 | 1.18            | 1.57            | 1.21            | 1.11            | -         |
| CD (P=0.05)  | NS       | 3.55            | 4.26            | 3.75            | 4.17            | NS       | 3.56            | 4.72            | 3.66            | 3.36            | -         |

**Note:** Figures in the table are mean values and those in parenthesis are angular transformed values.  
NS: Non-significant at 5% level of significance

Table 5 Effect of Different Pesticides against Jassids, *Amrasca biguttulabiguttula* on Tomato During February 2021 to June 2021

| Treatments   | Pre-treatment count | First spray       |                 |                 |                 | Pre-treatment count | Second spray      |                 |                 |                 | Mean  |
|--|---------------------|-------------------|-----------------|-----------------|-----------------|---------------------|-------------------|-----------------|-----------------|-----------------|-------|
|  |                     | Percent reduction |                 |                 |                 |                     | Percent reduction |                 |                 |                 |       |
|  |                     | 3 DAS             | 7 DAS           | 10 DAS          | 14 DAS          |                     | 3 DAS             | 7 DAS           | 10 DAS          | 14 DAS          |       |
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> )         | 1.2<br>3            | 52.50<br>46.44    | 57.71<br>49.45  | 65.83<br>54.26  | 61.88<br>51.89  | 1.3<br>0            | 52.64<br>46.51    | 58.06<br>49.14  | 67.50<br>55.25  | 62.92<br>52.51  | 59.88 |
| Imidacloprid 17.8% SL@ 68g a.i. /ha: (T <sub>2</sub> )             | 1.5<br>5            | 56.40<br>48.69    | 65.66<br>54.17  | 75.93<br>60.66  | 70.50<br>57.15  | 1.2<br>5            | 55.41<br>48.12    | 66.49<br>54.70  | 75.34<br>60.27  | 72.86<br>58.62  | 67.32 |
| Neem oil @ 3ml/lit of water: (T <sub>3</sub> )                     | 1.9<br>0            | 47.47<br>43.54    | 56.70<br>48.85  | 60.71<br>51.21  | 54.91<br>47.82  | 1.4<br>0            | 47.92<br>43.80    | 54.43<br>47.54  | 60.42<br>51.04  | 56.25<br>48.60  | 54.85 |
| <i>Beauveria bassiana</i> @ 0.2 ml/lit of water: (T <sub>4</sub> ) | 1.6<br>0            | 42.65<br>40.77    | 47.17<br>43.38  | 53.07<br>46.76  | 50.24<br>45.14  | 1.2<br>0            | 44.87<br>42.05    | 48.44<br>44.10  | 55.65<br>48.25  | 52.68<br>46.54  | 49.35 |
| Fipronil 5% SC @ 50 g/lit of water: (T <sub>5</sub> )              | 1.2<br>5            | 50.89<br>45.51    | 57.46<br>49.29  | 62.17<br>52.05  | 60.80<br>51.24  | 1.4<br>0            | 52.64<br>46.51    | 58.54<br>49.93  | 64.69<br>53.57  | 60.63<br>51.16  | 58.48 |
| Untreated control: (T <sub>0</sub> )                               | 1.6<br>0            | 0.00<br>(0.00 )   | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 2.0<br>0            | 0.00<br>(0.00 )   | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00<br>(0.00 ) | 0.00  |
| Sem±   | 0.3<br>1            | 1.25              | 1.34            | 1.23            | 1.10            | 0.1<br>7            | 1.19              | 1.29            | 1.24            | 1.22            | -     |
| CD (P=0.05)  | NS                  | 3.76              | 4.03            | 3.70            | 3.31            | NS                  | 3.58              | 3.88            | 3.75            | 3.68            | -     |

**Note:** Figures in the table are mean values and those in parenthesis are angular transformed values.  
NS: Non-significant at 5% level of significance

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Table 6 Effect of Different Pesticides against Leaf Miners, *Liriomyza bryoniae* on Tomato during February 2021 to June 2021

| Treatments  | First spray         |                   |                |                |                | Second spray        |                   |                |                |                | Mean  |
|---|---------------------|-------------------|----------------|----------------|----------------|---------------------|-------------------|----------------|----------------|----------------|-------|
|   | Pre-treatment count | Percent reduction |                |                |                | Pre-treatment count | Percent reduction |                |                |                |       |
|   |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |       |
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> )        | 2.75                | 44.49<br>41.83    | 48.44<br>44.10 | 56.54<br>48.77 | 52.83<br>46.63 | 1.45                | 44.97<br>42.11    | 48.61<br>44.20 | 57.12<br>49.09 | 53.47<br>47.00 | 50.81 |
| Imidacloprid 17.8% SL @ 68g a.i. /ha: (T <sub>2</sub> )           | 2.45                | 50.30<br>45.17    | 58.23<br>49.75 | 65.17<br>53.83 | 62.39<br>52.19 | 1.65                | 50.49<br>45.28    | 57.18<br>49.15 | 65.24<br>53.88 | 60.11<br>50.84 | 58.64 |
| N neem oil @ 3ml/lt of water: (T <sub>3</sub> )                   | 2.35                | 40.22<br>39.35    | 45.52<br>42.42 | 52.39<br>46.37 | 47.30<br>43.45 | 1.50                | 41.85<br>40.31    | 49.76<br>44.86 | 54.58<br>47.64 | 48.21<br>43.97 | 47.48 |
| <i>Beauveria bassiana</i> @ 0.2 ml/lt of water: (T <sub>4</sub> ) | 2.35                | 35.64<br>36.61    | 42.49<br>40.68 | 50.51<br>45.29 | 44.28<br>41.71 | 1.30                | 36.61<br>37.18    | 42.52<br>40.69 | 52.46<br>46.41 | 43.42<br>41.20 | 43.49 |
| Fipronil 5% SC @ 50 g/lt of water: (T <sub>5</sub> )              | 2.00                | 42.64<br>40.76    | 47.22<br>43.41 | 55.28<br>48.04 | 50.00<br>45.00 | 1.75                | 42.78<br>40.84    | 48.61<br>44.20 | 55.28<br>48.05 | 50.56<br>45.32 | 49.05 |
| Untreated control: (T <sub>0</sub> )                              | 2.75                | 0.00<br>(0.00)    | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 1.85                | 0.00<br>(0.00)    | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00  |
| Sem±  | 0.22                | 1.11              | 1.22           | 1.38           | 1.26           | 0.16                | 1.19              | 1.43           | 1.21           | 1.15           | -     |
| CD (P=0.05)   | NS                  | 3.35              | 3.69           | 4.16           | 3.81           | NS                  | 3.58              | 4.32           | 3.65           | 3.45           | -     |

Note: Figures in the table are mean values and those in parenthesis are angular transformed values.  
NS: Non-significant at 5% level of significance

Table 7 Effect of different pesticides against fruit borers, *Helicoverpa armigera* on tomato during February 2021 to June 2021

| Treatments   | First spray         |                   |                |                |                | Second spray        |                   |                |                |                | Mean  |
|--|---------------------|-------------------|----------------|----------------|----------------|---------------------|-------------------|----------------|----------------|----------------|-------|
|  | Pre-treatment count | Percent reduction |                |                |                | Pre-treatment count | Percent reduction |                |                |                |       |
|  |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |                     | 3 DAS             | 7 DAS          | 10 DAS         | 14 DAS         |       |
| Emamectin benzoate 5% SG @ 11 g a.i./ha: (T <sub>1</sub> ) | 0.00                | 0.00<br>(0.00)    | 0.00<br>(0.00) | 0.00<br>(0.00) | 0.00<br>(0.00) | 1.25                | 50.00<br>45.00    | 55.65<br>48.25 | 62.92<br>52.52 | 60.24<br>50.98 | 57.20 |
| Imidacloprid 17.8%   | 0.0                 | 0.00              | 0.00           | 0.00           | 0.00           | 1.3                 | 48.75             | 55.72          | 60.49          | 56.97          | 55.4  |

|  |      |        |        |        |        |      |       |       |       |       |       |
|--|------|--------|--------|--------|--------|------|-------|-------|-------|-------|-------|
| SL@ 68g a.i. /ha: (T <sub>2</sub> )                                | 0    | (0.00) | (0.00) | (0.00) | (0.00) | 5    | 44.28 | 48.29 | 51.06 | 49.01 | 8     |
| Neem oil @ 3ml/lit of water: (T <sub>3</sub> )                     | 0.00 | (0.00) | (0.00) | (0.00) | (0.00) | 1.45 | 44.44 | 50.69 | 55.56 | 52.43 | 50.78 |
| <i>Beauveria bassiana</i> @ 0.2 ml/lit of water: (T <sub>4</sub> ) | 0.00 | (0.00) | (0.00) | (0.00) | (0.00) | 1.50 | 40.97 | 44.10 | 48.26 | 42.01 | 43.84 |
| Fipronil 5% SC @ 50 g/lit of water: (T <sub>5</sub> )              | 0.00 | (0.00) | (0.00) | (0.00) | (0.00) | 1.50 | 46.53 | 52.78 | 58.68 | 55.21 | 53.30 |
| Untreated control: (T <sub>0</sub> )                               | 0.00 | (0.00) | (0.00) | (0.00) | (0.00) | 1.65 | 0.00  | 0.00  | 0.00  | 0.00  | 0.00  |
| Sem±   | -    | -      | -      | -      | -      | 0.16 | 1.34  | 1.21  | 1.46  | 1.72  | -     |
| CD (P=0.05)  | -    | -      | -      | -      | -      | NS   | 4.04  | 3.66  | 4.39  | 5.19  | -     |

Note: Figures in the table are mean values and those in parenthesis are angular transformed values.

NS: Non-significant at 5% level of significance

#### 4. CONCLUSIONS

Hence, it can be concluded that tomato is attacked by several insect pests in all the stages from vegetative till harvesting which needs serious attention of researchers. From this experiment, it is evident that new insecticides are effective in minimizing the population of different pests of tomato. It is suggested that further investigation should be carried out to study the reduced efficacy of certain insecticides so as to know the concrete results on their efficacy. Out of seven insect pests found, fruit borer, *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae), whitefly, *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae), aphid, *Aphis gossypii* Glover (Homoptera: Aphididae) and leaf miner, *Liriomyza bryoniae* Kaltenbach (Diptera: Agromyzidae) were found to be major insect pests. Among the insecticides used, Imidacloprid 17.8% SL was most effective against aphid, whitefly, leaf miner, and thrips. Emamectin benzoate 5% SG was found to be most effective against *Helicoverpa armigera*

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